DEMO908GZ60

Demonstration Module for Freescale 68HC908GZ60

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CAUTIONARY NOTES

1) Electrostatic Discharge (ESD) prevention measures should be used when handling this product. ESD damage is not a warranty repair item.

2) Axiom Manufacturing does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under patent rights or the rights of others.

3) EMC Information on the DEMO908GZ60 module:

   a) This product as shipped from the factory with associated power supplies and cables, has been verified to meet with requirements the FCC as a **CLASS A** product.

   b) This product is designed and intended for use as a development platform for hardware or software in an educational or professional laboratory.

   c) In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate prevention measures.

   d) Attaching additional wiring to this product or modifying the products operation from the factory default as shipped may effect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

TERMINOLOGY

This development module uses option selection jumpers. A jumper is a plastic shunt that connects 2 terminals electrically. Terminology for application of the option jumpers is as follows:

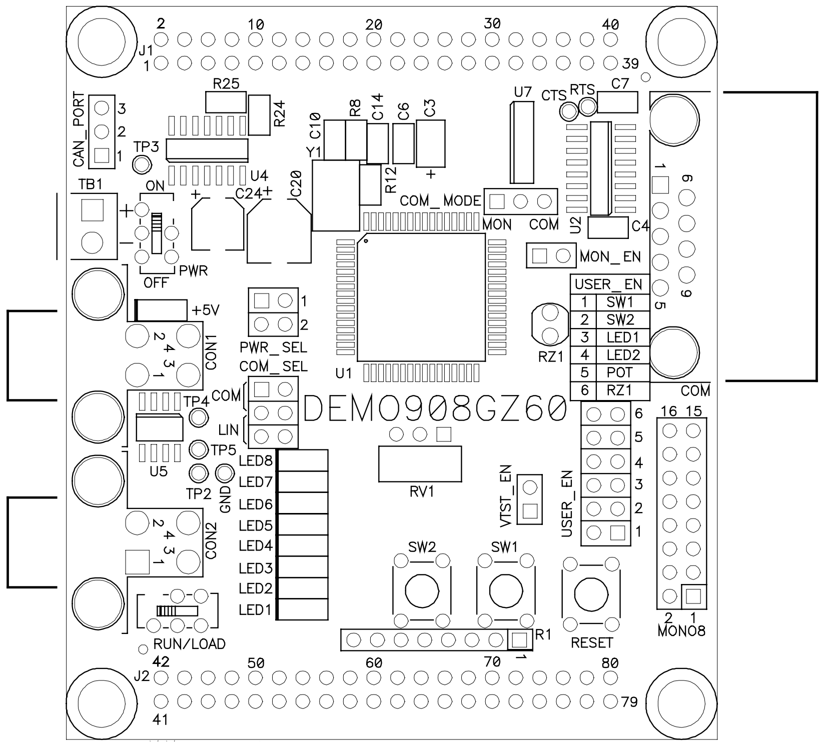
Jumper on, in, or installed - jumper is installed such that 2 pins are connected together.

Jumper off, out, or idle - jumper is installed on 1 pin only. It is recommended that jumpers be idled by installing on 1 pin so they will not be lost.

Cut-Trace – a circuit trace connection between component pads. The circuit trace may be cut using a knife to break the default connection. To reconnect the circuit, simply install a suitably sized 0-ohm resistor or attach a wire across the pads.

FEATURES

The DEMO908GZ60 is an evaluation or demonstration module for the 68HC908GZ60 microcontroller. Development of applications is quick and easy with the included wall plug, DB9 serial cable, sample software tools, and examples. The MON08 port is provided for development tool application and is compatible with HC08 monitor interface cables and software. The module provides options to allow MON08 access through the COM port also. A 40-pin MCU I/O connector (J1) allows interfacing the DEMO908GZ60 module to external connections.



Features:

- 68HC908GZ60 CPU
  - 64 LQFP
  - 60K Byte Flash
  - 2K Bytes Ram
  - 53 I/O lines, 13 Dedicated
  - 16-bit, 2-Ch Timer w/ IC/OC/PWM
  - 16-bit, 6-Ch Timer w/ IC/OC/PWM
  - SCI and SPI Communications Ports
  - 8 Key Board Wake-up Ports
  - ADC
  - 4Mhz Internal Bus Operation
- Regulated +5V power supply
- Power Input Selection Jumper
- Optional power input from Connector J1
- Optional power output through Connector J1
- 8 MHz Ceramic Resonator
- RS-232 COM Serial Port w/ DB9 Connector
- Optional MON08 Interface through COM Port
- User Components Provided
  - 3 Push Switches; 2 User, Reset
  - 3 LED Indicators; 2 User, +5V
  - Run/Load Slide Switch
  - On/Off Slide Switch
- Option Jumpers
  - Enable User Component
  - Power Select
  - OSC_SEL
  - COM_SEL
  - MON_EN
  - VTST_EN
- Connectors
  - 2 40-pin MCU I/O Connector, stack through type
  - 2-Position, Screw-type, Power Input Terminal Block
  - MON08 Debug Cable Header
  - DB9 Serial COM Connector
- Supplied with DB9 Serial Cable, Documentation (CD), and Manual.

Specifications:
Module Size 2.45” x 3.1”
Power Input: 9VDC @ 200 mA typical, +6 to +16VDC,

Reference Documentation

Reference documents are provided on the support CD in Acrobat Reader format.

DEMO908GZ60_SCH_C.pdf	DEMO908GZ60 Module Schematic Rev. C
DEMO908GZ60_UG.pdf	DEMO908GZ60 User Guide (this document)
MC68HC908GZ60/D.pdf	68HC908GZ60 Device User Guide

See the HC08 Support CD provided with this board for all the documentation and support files provided.

GETTING STARTED

The DEMO908GZ60 Module operates in two basic Modes, Run Mode, or MON08 Debug Mode. Run Mode supports user application operation from Power On or Reset condition. MON08 Debug Mode supports the development and debug of applications via the MON08 embedded debug monitor. See the related sections below for quickly starting the module in the desired operation mode.

The Module may be operating a Demonstration (DEMO) program when shipped from the factory. If so, the Module kit contents will include a Quick Start document explaining the operation of the Demonstration program. The demo program operates in RUN Mode.

The module must be powered to operate. The +5V will light when the board is powered from the on-board regulator, or if the board is setup to provide power to an external circuit through connector J1. The +5V LED should not light when the board is powered through connector J1. If it does, the PWR_SEL jumper is incorrectly configured and may result in damage to the on-board regulator. Refer to the PWR_SEL option and J1 connector chapter for more detail on these selections.

RUN MODE

RUN Mode operates the HC08 application contained in the internal flash memory from Reset or Power On condition. Use the following settings to configure the DEMO908GZ60 module for RUN Mode to get started quickly.

1. Configure PWR_SEL option for input supply to power the module. If supply is via J1 connection, install module on J1 external connection in powered down condition.

2. Connect serial communication cable between the module COM port and the host if needed. Launch supporting host software for the module communication.

3. Set module options for RUN Mode:

VTST_EN	Off / open / idle
MON_EN	Off/ open / idle
COM_EN	2-3 (COM position)
RUN/LOAD	Set to RUN
USER_EN	Enabled as needed for application operation

4. Power On the Module. Application will begin to execute.

MON08 DEBUG MODE on COM

MON08 Monitor Mode operates the HC08 internal MON08 debug monitor from Power-On. This mode is accessible by setting Module options or by applying a supporting development cable to the Debug Port. For Debug cable application, the state of the MON_EN option jumpers is DON'T CARE. The COM_EN option jumper should be set to the 2-3 position. The VTST_EN jumper may be required. Refer to the MON08 Configuration section of this document for further details. The following settings configure the DEMO908GZ60 module for MON08 Debug Mode on COM:

1. Configure PWR_SEL option for input supply to power the module. If supply is via J1 connection, install module on J1 external connection in powered down condition. Note that the VTST_EN option requires 9VDC minimum applied at TB1 to function correctly.
2. Connect one end of the supplied 9-pin serial cable to a free COM port on the PC. Connect the other end of the cable to the COM port connector on the DEMO908GZ60 module.
3. Install and launch the PC Hosting software for the MON08 communication interface. This may be a C compiler with IDE and MON08 communication or another MON08 debug hosting type software.
4. Set the Module options for MON08 Debug Mode:

VTST_EN	ON / Installed on both pins (required if the Reset vector is not erased in the flash memory)
MON_EN	ON / Installed on both pins
COM_EN	1-2 (DEBUG position)
USER_EN	Enabled as needed for application operation

5. Apply +9VDC minimum power to the module. This may be applied by TB1 or through J1.
6. Hosting development software will establish MON08 communication now.

Software Development

Software development will require the use of an HC08 assembler or compiler and a host PC operating a MON08 debug interface. Supplied with this board is the Motorola MCUez HC08 assembler tools along with the Axiom MON08 IDE for Windows for Debugging and Flash programming. A demonstration or evaluation copy of a C compiler may also be provided.

A powerful source code generation tool called DriveWay™ is also provided on the support CD. This can generate C source code for the HC08 microcontroller peripherals, based on setup. See the DriveWay™ readme.txt file for more information.

MEMORY MAP

0x0000	0x003F	Registers	64 bytes
0x0040	0x043F	RAM-1	1024 bytes
0x0440	0x0461	Registers	34 bytes
0x0462	0x04FF	Flash-2	158 bytes
0x0500	0x057F	MSCAN	128 bytes
0x0580	0x097F	RAM-2	1024 bytes
0x0980	0x1B7F	Flash-2	4608 bytes
		Reserved	
0x1E00	0x1E0F	Monitor ROM	16 bytes
		Reserved	
0x1E20	0x7FFF	Flash-2	24.5K bytes
0x8000	0xFDFF	Flash-1	31.5K bytes
0xFE00	0xFE0E	Status and Control	15 bytes
0xFE0F	0xFE1F	Unimplemented	
0xFE20	0xFF7F	Monitor ROM	352 bytes
0xFF80	0xFF88	Flash Control	8 bytes
0xFF89	0xFFCB	Reserved	
0xFFCC	0xFFFF	Vectors	52 bytes

NOTE: The memory map above generally describes the MCU Memory Map. Refer to the 68HC908GZ60 documentation for a detailed memory map.

OPERATION

The DEMO908GZ60 module provides input and output features to assist in microcontroller application development. The user has access to MCU ports through connectors J1 and J2. Each connector is a 40-position pass-through socket type connector mounted on the bottom of the module. Insertion of pin headers is possible from the top or bottom of the module. This allows stacking or connecting the module as needed. Connector J1 may be used to apply power to the module as well as RS-232 communications signals. Care must be exercised when using the MCU_PORT to power the module, as only regulated +5V DC should be applied to this connection. The PWR_SEL option jumper configures the module to accept input power on connector J1 or to provide regulated +5V to an external device attached to connector J1.

Multiple option jumper blocks configure module operation. Enabling an associated option requires installing a jumper, or shunt, across the appropriate header pins so that both pins are connected via the jumper. Removing the shunt disables the associated option.

POWER SUPPLY

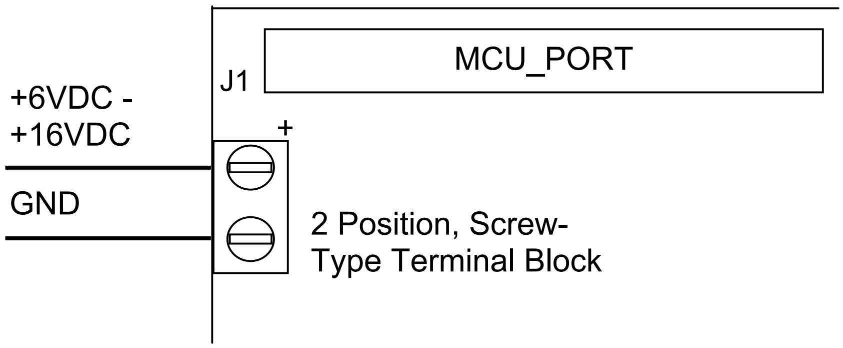
Input power may be applied by external connection to a 2 position terminal block and 5V regulator or directly from connector J1. The input supply is selected by the PWR_SEL option.

TB1 – Terminal Block

The TB1 terminal block allows external voltage to be supplied to the module. Input voltage should be limited to +6VDC and +16VDC; +9VDC is typical. The terminal block is a 3.55mm, screw-type, connector that accepts a maximum 18 AWG wire. An on-board voltage regulator (VR1) converts the input voltage to the +5VDC used by the module. Bulk capacitance on the regulator input and output provides noise immunity on the power input.

Reverse polarity protection is provided at the Terminal Block input. This will prevent damage to the module if the input voltage is inadvertently reversed.

Figure 1: TB1 Terminal Block Connector



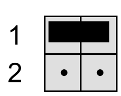
PWR_SEL Jumper

The PWR_SEL jumper selects the source of power input to the module, or provides+5VDC to J1 for use by external circuits. The module takes voltage input from the 2-position on-board voltage regulator or from the 40-pin MCU connector (J1). Power input at the terminal block must be DC voltage between +7VDC and +16VDC. Power input on the MCU connector **must be** regulated voltage between +4.75VDC and +5.25VDC. The MCU_PORT connector power input allows use of batteries, or other alternate sources, to power the module.

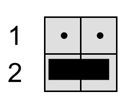
CAUTION: Module damage may occur if the MCU_PORT power input pins (J1-1, J1-3) are over-driven.

The PWR_SEL option jumper provides 3 possible configurations; source power from the PWR connector, source power from J1, or source power from PWR and supply power to J1. The figure below shows the settings for each configuration.

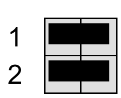
Figure 2: PWR_SEL Jumper Settings



Module powered from external input connected to J1-1 (+) and J1-3 (-). +5VDC Maximum input voltage.



Module powered from external +6VDC - +16VDC connected to TB1 Terminal Block. J1-1 is open or not connected.



Module powered from external +6VDC - +16VDC connected to TB1 Terminal Block. Module provides +5VDC output at pin J1 for use by external circuits.

NOTE: Power output from the module is limited by the 250 mA maximum output of the on-board voltage regulator.

NOTE: External circuit connected to J1 should limit current flow to less than 50 mA to prevent current-limiting the power supply (VR1).

Power Switch

A Power Switch (PWR_SW) has been provided between the input Terminal Block and the voltage regulator to allow the user to turn the board on and off. The Power Switch connects or disconnects only power applied to the terminal block. Voltage applied to connector J1 is not affected by this switch.

Reset Switch

The RESET switch provides a method to apply an asynchronous reset to the module. Pressing the RESET switch applies a low voltage level to the RST* input. A resistor tied to the high voltage rail prevents spurious RESET input to the MCU. A capacitor tied to ground holds the signal line low for a sufficient amount of time.

Timing

An 8 MHz ceramic resonator at Y1 provides timing to the DEMO908GZ60. This allows a default 4.0 MHz internal operating frequency. Using the embedded PLL, the internal bus frequency can be increased to a maximum of 8 MHz. The resonator output is routed to the MCU only and is not available at connector (J1).

Connectors J1 and J2

Connectors J1 and J2 are 40-pin, surface-mount, socket headers mounted on the bottom of the module. Each connector is mounted over plated-through holes in the PCB. The socket is a pass-through type socket designed to allow header insertion from either the top or bottom. These connectors provide maximum flexibility allowing the module to connect directly to an expanded development environment or to test equipment. Access to all MCU signals is available at connector J1 or J2.

Power may be supplied to the module through pins J1-1 (+V) and J1-3 (GND). Use of this option requires input voltage between +4.75VDC and +5.25VDC. This input directly connects to the module power and ground planes. Care should be exercised not to over-drive this input. J1 can also be used to source power from the on-board regulator to external modules. The PWR_SEL option header determines how power is routed to and from the module.

> **NOTE:** Power output from the module is limited by the 250 mA maximum output of the on-board voltage regulator.

The table below shows the pin-out for the MCU IO Connectors.

Table 1: MCU IO Connectors

	J1		
V_X	1	2	IRQ*
GND	3	4	RESET*
PET0/TXD	5	6	PTA2/KBD2/AD10
PTE1/RXD	7	8	PTA3/KBD3/AD11
PTA0/KBD0/AD8	9	10	PTB0/AD0
PTA1/KBD1/AD9	11	12	PTB1/AD1
PTD4/T1CH0	13	14	PTB2/AD2
PTD5/T1CH1	15	16	PTB3/AD3
PTD2/MOSI	17	18	PTB4/AD4
PTD1/MISO	19	20	PTB5/AD5
PTD3/SPSCK	21	22	PTB6/AD6
PTD0/SS*/MCLK	23	24	PTB7/AD7
PCT2	25	26	PTC0/CANTX
PCT3	27	28	PTC1/CANRX
PCT4	29	30	PTA24/KBD4
PCT5	31	32	PTA5/KBD5/AD13
PCT6	33	34	PTD6/T2CH0
PTE2	35	36	PTD7/T2CH1
PTE3	37	38	PTA6/KBD6/AD14
PTE4	39	40	PTA7/KBD7/AD15

	J2		
PTE2	41	42	NC
PTE3	43	44	NC
PTE4	45	46	NC
PTE5	47	48	NC
PTF0	49	50	NC
PTF1	51	52	NC
PTF2	53	54	NC
PTF3	55	56	NC
PTF4/T2CH2	57	58	NC
PTF5/T2CH3	59	60	NC
PTF6/T2CH4	61	62	NC
PTF7/T2CH5	63	64	NC
PTG0/AD16	65	66	NC
PTG1/AD17	67	68	NC
PTG2/AD18	69	70	NC
PTG3/AD19	71	72	NC
PTG4/AD20	73	74	NC
PTG5/AD21	75	76	NC
PTG6/AD22	77	78	NC
PTG7/AD23	79	80	NC

Communications

The DEMO908GZ60 module provides a single serial communications port and a single CAN communications port. The Enhanced SCI port supports both RS-232 and Local Interconnect Network (LIN) protocols. An option jumper (COM_SEL) selects between the communications protocol implemented. The CAN port utilizes a direct data connection to the MCU and provides a 3-pin header to connect off-board circuits.

RS-232 Communications

An RS-232 translator (U2) provides RS-232 signal level to TTL/CMOS logic level translation on the COM port. Signals TXD and RXD are routed between the transceiver and the MCU. These signals are also routed to connector J1. RS-232 communication signals input on J1 must be TTL/CMOS logic levels; no translation support is provided through this path. The transceiver output may also be driven off-module if a suitable interface is used. As added development support, hardware flow control signals RTS and CTS are available on the logic side of U3. These signals are routed to vias located near the transceiver (U3). RTS has been biased properly to support 2-wire RS-232 communications.

Use of the J1 connector to input RS-232 signals requires disabling the on-board RS-232 transceiver to prevent signal corruption. Disabling the on-board transceiver is accomplished by removing the COM_SEL jumper. Details on the COM_SEL jumper are shown in the table below. The figure shows the jumper position to enable RS-232 communications.

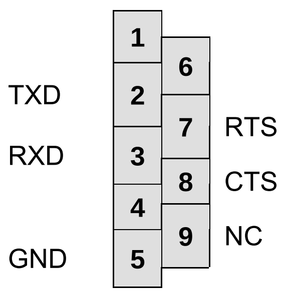
Table 2: COM Connections

HC08 Port	MCU Pin	COM Signal	I/O PORT Connector
PTE0/TXD	U1-2	TXD OUT	J1-5
PTE1/RXD	U1-3	RXD IN	J1-7

COM Connector

A standard 9-pin Dsub connector provides external connections for the SCI port. The SCI port provides an alternate interface for use with the MON08 monitor. Component U2 provides RS-232 translation services. The figure below details the DB9 connector.

Figure 3: COM Connector

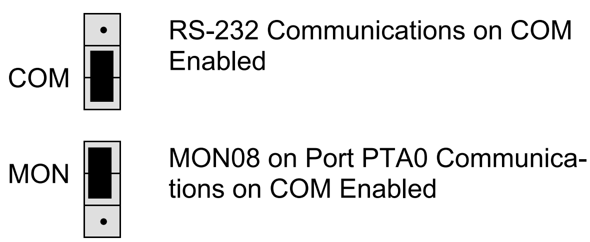


Female DB9 connector that interfaces to the HC08 internal SCI1 serial port via the U2 RS232 transceiver. It provides simple 2 wire asynchronous serial communications without flow control. Flow control is provided at test points on the module.

Pins 1, 4, and 6 are connected together for NULL status to the host.

The communications mode of the COM port is determined by the COM_SEL jumper. This 3-pin jumper allows the user to select between SCI serial communications and single-wire MON08 communications.

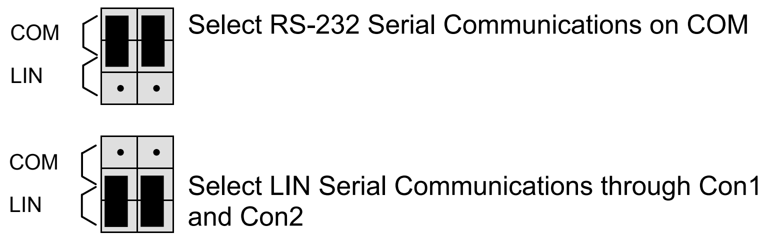
Figure 4: COM_MODE Jumper



COM Select Jumper

The COM_SEL jumper selects between the RS-232 protocol or the LIN protocol on the MCU SCI port.

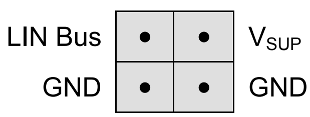
Figure 5: COM_SEL Jumper



LIN Communications

The DEMO908GZ60 implements a single Local Interconnect Network (LIN) interface on the ESCI port. The LIN physical interface consists of a MC33661 transceiver at U5 and 2 4-position Molex Mini-Fit connectors at CON1 and CON2. The LIN interface supports data transmission speeds up to 20 kbps. The LIN interface is configured in a Master – Slave configuration with a single master controlling multiple slaves.

Figure 6: LIN Connector – CON1, CON2



NOTE: Signal assignment looking into connector on PCB
Mating Connector: Molex P/N 39-01-2040
Connector Pins: Molex P/N 39-00-0039

CAN Communications

The DEMO908GZ60 implements a single Fault-Tolerant Controller Area Network (CAN) interface. CAN is used to high-speed and fault-tolerant automotive networks. The CAN physical interface consists of a MC33388 transceiver at U 4 and a single 3-position header. The transceiver converts serial data from the MCU to differential data for the CAN bus. The physical layer implemented supports data rates up to 125 kbps. The differential bus termination voltage is provided by the physical interface. The figure below details the pin-out of the CAN bus connector.

Figure 7: CAN Bus Connector

3	CANL	Negative CAN Bus Signal
2	GND	PCB Ground
1	CANH	Positive CAN Bus Signal

MON08 Communications

The DEMO908GZ60 provides 2 methods for accessing the internal monitor. Serial MON08 access is provided through the COM port. A MON08 compatible programming pod may also attach to the 14-pin MON08 port. Monitor mode is enabled by the COM_Mode, MON_EN, and VTST_EN option jumpers. Some MON08 pods can supply VTST directly eliminating the need

to set the VTST_EN option jumper. The MCU supports monitor mode communications at 7200 bps. Refer to MON08 pod documentation for further details.

The internal monitor may also be accessed through and the through COM connector. As above, MON08 mode, through the COM port, is enabled by the COM_SEL, the MON_EN, and VTST_EN option jumpers. This allows MON08 debugging without the expense of a 3rd-party MON08 pod. The table below shows the selection settings for the COM_SEL jumper. The MCU supports monitor mode communications at 7200 bps.

MON08 Configuration

The following group of figures show the setting necessary to configure the DEMO908GZ60 for monitor mode. The MON_EN jumper setting enable communication between the COM port and the MCU MON08 port, The VTST_EN jumper provides the high voltage necessary to force the MCU to monitor mode. The COM_SEL jumper disables the RS-232 interface to prevent corrupting the serial data stream.

Figure 8: MON_EN Jumper Setting

ON	MON08 Monitor Mode Signaling Enabled
OFF	MON08 Monitor Mode Signaling Disabled

Figure 9: VTST_EN Jumper Setting

ON	IRQ* signal line set to 8.2V. MON08 monitor mode force entry enabled.
OFF	IRQ* signal line pulled up to V_{DD}. MON08 monitor mode available if Reset vector is erased.

NOTE: To utilize the MON08 monitor mode, the input voltage must exceed 9.0VDC**.**

The following table details the settings necessary to configure the MCU for MON08 monitor mode operation via the COM port.

Figure 10: MON08 on COM Setup

MON_EN	ON	MON08 Signaling Enabled
VTST_EN	ON	Force MON08 Monitor Mode
COM_MODE	MON	MON08 Signaling Enabled

NOTE: To utilize the MON08 monitor mode, the input voltage must exceed 9.0VDC.

MON08 PORT

The MON08 port is a 16-pin header compatible with a Motorola MON08 Monitor Mode Pod. This allows the connection of a background debugger for software development, programming, and debugging in real-time without using HC08 I/O resources.

Figure 11: MON08 Port Connector

	1	**2**	GND
	3	**4**	RST*
	5	**6**	IRQ1*
	7	**8**	PTA0
	9	**10**	PTA1
	11	**12**	PTB0
OSC1	**13**	**14**	PTB1
V_{DD}	**15**	**16**	PTB4

See the HC08 Reference Manual for complete MON08 documentation

When using the MON08 pod to access monitor mode, care must be exercised to configure the host software correctly. Many MON08 Pods are capable to powering the target board through the MON08 Port. In this case, the appropriate voltages will be applied to the board and the state of the monitor configuration jumpers is DON'T CARE. If the board is not powered through the MON08 Port, then the minimum applied voltage is +9VDC and the VTST_EN jumper must be installed. Regardless of how the board is powered, the state of the MON_EN jumper is DON'T CARE. When using the MON08 Port for monitor access, the COM_MODE jumper should be set to 2 – 3 to allow RS-232 communications.

Figure 12: MON08 on Port Setup

MON_EN	ON / OFF	Don't Care
VTST_EN	ON / OFF	On if VTST Voltage not supplied by MON08 Pod. Else, Don't Care.
COM_MODE (COM)		RS-232 Signaling Enabled

NOTE: If powered externally, +9VDC must be applied and VTST_EN jumper must be installed. Else, the board may be powered from the MON08 Pod and VTST_EN is DON'T CARE.

USER Components

The DEMO908GZ60 provides 2 user push switches, 2 user LED indicators, a potentiometer, and photocell circuit for user applications. USER_EN option jumper allows each option to be enabled or disabled individually. To enable a user option, simply install the appropriate jumper. Remove the jumper to disable an option.

Table 3: USER_EN Option Settings

Jumper	On	Off	MCU PORT
User 1	Enable SW1	Disable SW1	PTC6 (U1-45)
User 2	Enable SW2	Disable SW2	PTC5 (U1-44)
User 3	Enable LED1	Disable LED1	PTF0 (U1-8)
User 4	Enable LED2	Disable LED2	PTF1 (U1-9)
User 5	Enable POT	Disable POT	PTB2 (U1-32)
User 6	Enable SENSOR	Disable SENSOR	PTB3 (U1-33)

Pushbutton Switches

Two push button switches provide momentary active low input for user applications. SW1 and SW2 are enabled to the HC08 I/O ports by the USER option bank. SW1 and SW2 provide input to HC08 I/O ports PTC6 and PTC5 respectively.

LED Indicators

Indicators LED1 and LED2 are enabled from HC08 I/O ports by the USER_EN option. The LED indicators are active low and illuminate when a logic low (0V) signal is driven from the respective MCU I/O port. MCU ports PTF0 and PTF1 drive LED1 and LED2 respectively.

RV1 Potentiometer

A 5k Ω, thumb-wheel potentiometer at RV1 provides variable resistance output for user applications. The device provides a 0 to VDD (+5V typical) output to the PTB2 input when enabled.

RZ1 Photocell

A visible-light sensitive photocell (RZ1) with an amplifying OPAMP circuit provides a variable voltage output for user applications. Circuit output voltage ranges between .5V to VDD typical and is inversely proportional to light intensity on the surface of the sensor (VDD = Dark). When enabled, the circuit output voltage is provided to MCU port PTB3 input for user application.

APPENDIX A

BILL OF MATERIALS

Item	Qty	Title	Ref	Mfr	Mfr-P/N
1	3	Cap, Tant, 10uF, 10V, SMB	C3, C16, C23	Avx	TAJB106K010R
2	1	Cap, Elect, 100uF, 16V, Alum, SMD	C20	Nichicon	UWX1C101MCL1GB
3	1	Cap, Elec, 10uF, 35V, Alum, SMC	C24	Nichicon	UWX1V100MCL1GB
4	5	Cap, Mon, 1uF, 16V, 0805	C1, C4, C7, C8, C9		
5	7	Cap, Mon, .1uF, 50V, 0805	C11, C15, C17, C18, C19, C22, C25	Meritek	MA080525U104M500
6	7	Cap, Mon, .01uF, 50V, 0805	C2, C5, C6, C12, C13, C14, C21		
7	1	Cap, Mon, .033uF, 25V, 0805	C10,		
	1	Res, Ntwk, 100K ohm, 8P7R, Bussed	R1		
8	2	Res, Carbon, 510 ohm, 5%, 1/16W, 0805	R24, R25		
9	11	Res, Carbon, 1K ohm, 5%, 1/16W, 0805	R6, R7, R9, R13, R18, R19, R20, R21, R22, R27, R32		
10	9	Res, Carbon, 10K ohm, 5%, 0805	R8, R10, R23, R28, R29, R34, R35, R36, R39		
11	1	Res, Carbon, 20K ohm, 5%, 0805	R38		
12	1	Res, Carbon, 33K ohm, 5%, 1/16W, 0805	R26		
13	2	Res, Carbon, 47K ohm, 5%, 0805	R11, R33		
14	7	Res, Carbon, 100K ohm, 5%, 1/16w, 0805	R14, R15, R16, R17, R30, R31, R37		
15	1	Res, Carbon, 1M ohm, 5%, 1/16w, 0805	R12		
16	1	Res, Pot, 5K ohm, 9mm vert.	RV1	Bourns	3352W-1-502
17	1	Photocell, 30K -1M	RZ1	Photonic	PDV-P9003
18	1	Resonator, Cer, 8.00MHz, w/Caps, 3Pos, SMT	Y1	Panasonic	EFO-S8004E5
				ECS	ECS-SR1-8.00-B
				AVX/Kyocera	PBRC-8.00HR
				Murata	CSTCC8M00G53-R0
19	2	Diode, Rect, S1A, 1A, 50V, DO214AC	D1, D2	Vishay	S1A
20	1	Diode, Zener, 8.2V, 5%, 225mW, SOT23	D3	On Semiconductor	MMBZ5237BLT1
21	1	Diode, Schottky, 30V, 200mA, BAT54C, Com. Cathode, SOT23	D4	General Sem.	

22	9	LED, Green, w/reflector, 1206, SMT	LED1, LED2, LED3, LED4, LED5, LED6, LED7, LED8, +5V	Rohm	SML-010MTT86
23	1	Ind, Ferrite, EMI, 330 ohm @ 100 MHz, 1.5A, 0805	FB1	Mouser	81-BLM21P331SG
24	1	Ind, 10uH, 10%, 1210	L1	Vishay	IMC1210SY100K
25	1	IC, MCU, MC68HC908GZ60, 64LQFP	U1	Motorola	MC68HC908GZ60CFU
26	1	IC, CAN XCVR MC33388D, SOIC14	U4	Motorola	MC33388D
27	1	IC, LIN XCVR, MC33661D,SOIC8	U5	Motorola	MC33661D
28	1	IC, Dual RS232 XCVR, 3.3V, ESD, 16SOIC	U2	Intersil	ICL3232ECBN
29	1	IC, OPAMP, Single, SOT23-5	U3	Fairchild	LMV321AS5X
30	1	IC, Hex Inv, 74AC04, 14SOIC	U6	STM	74AC04MTR
31	1	IC, Quad Buf, 3-state, TTL, 14SOIC, 74ACT125	U7	STM	74ACT125M
32	1	VReg, LDO, 5.0V, 250mA, 8 SOIC	VR1	STMicroelectronics	L4931CD50
33	3	Sw, PB, 5mm Sq, Thru	SW1, SW2, RESET	E-Switch	EG1827
34	2	Sw, Slide, SPDT, Thru L=2MM	RUN/LOAD, PWR_SW	E-Switch	EG1271
35	2	Conn, 2x20 Socket Hdr, Pass Thru, .1", Bottom Entry, SMT	J1, J2	Samtec	SSM-120-L-DV-BE-K-A
36	1	Conn, Term Blk, 2Pos, 3.55mm, thru	TB1	On Shore Technology	ED555/2DS
37	1	Conn, Dsub, 9P, F, RA, PCB Mount	COM		
38	2	Conn, Mini-fit 4 position, RA, thru	CON1, CON2		
39	2	Conn, 1x2, Pin Header, .1" Ctr, Thru	MON_EN, VTST_EN		
40	2	Conn, 1x3 Pin Header, .1" Ctr, Thru	CAN_PORT, COM_MODE		
41	1	Conn, 2x2 Pin Header, .1" Ctr, Thru	PWR_SEL		
42	1	Conn, 2x3 Pin Header, .1" Ctr, Thru	COM_SEL		
43	1	Conn, 2x6 Pin Header, .1" Ctr, Thru	USER_EN		
44	1	Conn, 2x8 Pin Header, .1" Ctr, Thru	MON08		
45	4	Hdw, Stand-off, .250x.375, Hex, Alum		Keystone	2202
46	4	Hdw, Screw, 4-40x3/8, 18-8, SS			
47	14	Hdw, Shunt, 2 Pos, .1"		Generic	
48	1	PCB, DEMO908GZ60, 2 layer, 3.2 x 2.2			